Readme – 4ch Vibration Analyzer

1. INSTALL THE SOFTWARE FIRST

The software installs the necessary drivers for Microsoft Windows to recognize your National Instruments (NI) data acquisition device or sound card. Any sound card recognized by Microsoft Windows will be detected by this software and available as a data acquisition input.

2. ACCELEROMETER TYPES SUPPORTED

This software will work best with any type of accelerometer that provides a voltage output. MEMS Accelerometers are an example: They just required that you have an external power source like a battery or a 3 to 5V power source. IEPE accelerometers are another example of supported sensor. IEPE accelerometers are also called ICP™, ISOTRON, CCLD, or Deltatron. These names vary by manufacturer, but they all mean the same thing: electronics are built into the accelerometer and a DC excitation current from 2mA to 20mA is sent automatically along the cable from the instrument. This current powers the electronics inside the accelerometer. There are many instruments that provide this current, and the "precision suggestion" (section 4) will handle this automatically. The accelerometer should have a specification of "mV/g".

NOTE: The "low-cost" and "precision" options (listed below) include the proper signal conditioning for ICP or IEPE type accelerometers. You just have to select the appropriate sensor depending on the expected g levels. For the "MEMS" type accelerometers, any data acquisition card listed will work.

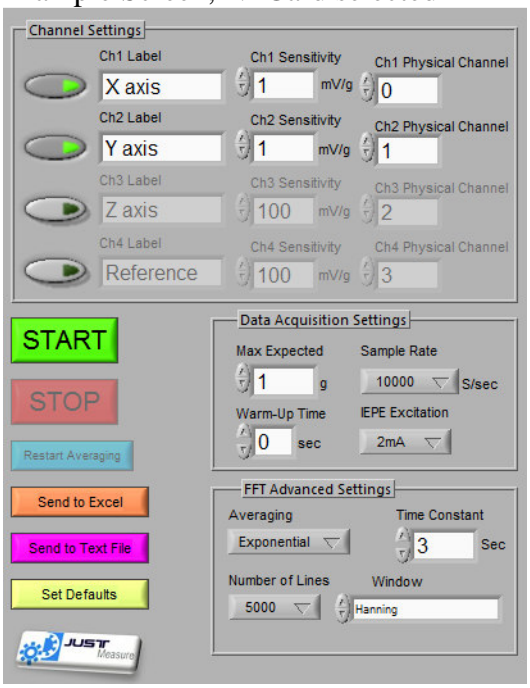
3. SENSOR MOUNTING / CONSIDERATIONS

The best way to mount the accelerometer whenever possible is to use a "spot face" tool to create a very clean, smooth, and flat surface with a small screw hole in the middle. The method of creating this hole is generally called "drill-and-tap". It is often not feasible to drill into the object under test (even a fraction of an inch which is all that's required for the screw hole), and it's not critical to drill-and-tap for frequencies in the 500Hz and lower range. In this case, you can use a magnet or a small dab of cyanoacrylic (superglue) or beeswax. In every case, you want the surface to be clean and flat. Some magnets are designed for curved surfaces if your requirement is on a cylindrical shape such as a pipe.

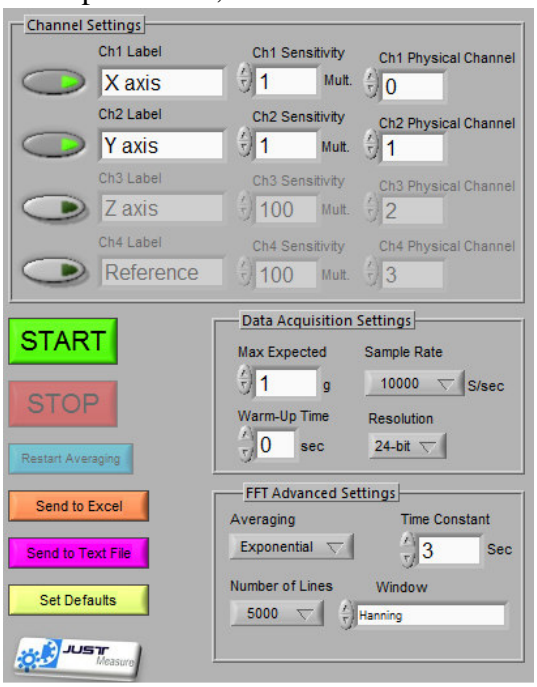
4. OPERATION OF SOFTWARE

You can double click the "4ch Vibration Analyzer" link on your desktop or from Start Menu -> Programs -> JustMeasure. Once the software is launched, the next step is to provide a few parameters for the software to operate properly in this section:

Example Screen, NI Card selected



Example Screen, Sound Card selected:



"Chx Label"

This does not affect the data, but is a descriptive term for the channel. This will be shown in acquisition mode within the software and used a column header when the data is exported to Excel.

NOTE: If you are using a sound card, you must only select as many channels as available or you will receive an error! The oval buttons in the upper left-hand corner allow you to select or de-select an available channel. For most sound cards, you cannot enable more than 2 channels at a time as most sound cards only have 1 or 2 input channels.

"ChX Sensitivity"

You can input the sensitivity of the sensor (in mV/g), which will be provided on the calibration sheet from the manufacturer if you're using an NI Data Acquisition card. If you're using a sound card, the data will return 1.000 for a full scale positive input and -1.000 for a full scale negative input. ChX sensitivity, in the case of a sound card, is a multiplier for this value.

NOTE: The software will accept "sensitivity" values from .001 to 10,000.

"ChX Physical Channel"
These represent the hardware channel of your data acquisition device (NI Cards only). For example: You may have 20 accelerometers attached to your National Instruments Data Acquisition device, and you only want to read 3 at a time in multiple passes. The software allows you to select the hardware channel so you don't have to physically disconnect and reconnect the sensors. For sound cards, you can skip or scan channels out of order, and these have to be in consecutive, increasing order.

"Max Level (Expected)"
Input the maximum vibration levels you will need to measure in g's. If you don't know what kind of vibration to expect, try a test run using the maximum range of the accelerometer you've chosen.

"Sampling Rate"
You can choose from a pre-selected list of sampling rates or you can choose to enter your own sampling rate. Whether you're using a sound card or National Instruments Data Acquisition device, the software will support any sample rates available from the device.

"Warm-Up Time"
For select National Instruments devices only: This allows you to turn on the IEPE excitation to the device and let the device settle before the data acquisition starts. The "Warm-Up Time" clock starts after the start button is pressed.

"Start"
This immediately starts the data acquisition (unless you have designated a warm-up time), posting both real-time FFT and time domain data to the graphs on the right.

"Pause"
This will stop the sampling and hold the most recent second of data for your viewing pleasure on the screen. From here, you can hit "Start" again to re-start the acquisition and pause later, or you can hit "Export to Excel". After the data is exported, you can re-start another measurement or exit.

"Export to Excel"
This will automatically open Microsoft Excel (required on your PC) and populate the data results with the date / time and levels (in g's) at every frequency.

"Export to Text File"
This will prompt you for a file dialog. You can navigate to the desired folder and create any file name you desire including the extension. The data will be saved in ASCII tab-delimited format with the name of each column as headers. This is ideal to drag-and-drop into a spreadsheet like Excel or to easily import into an application like Matlab.

"Set Defaults"
This writes a small text file to your hard disk to permanently store your selections for the next time you run the software.

"Time Constant"
The function of the time constant variable depends on the averaging choice. When averaging is selected to "none" or "Peak", this value has no meaning and is disabled. When set to "Exponential", this is the time decay constant for exponential FFT averaging. When set to "linear", this is a stop clock to automatically stop the data acquisition.

"Number of Lines"
This allows you to select the number of lines returned with the FFT. This value, along with the sampling rate, dictates how long it takes between measurements to return data to the screen. You will be warned if this is over 2 seconds long and will be asked to accept before starting.

"Window"
This is an advanced method of manipulating the FFT data, and beyond this scope of this ReadME. If you don't know what it is, the default mode recommended is "hanning".

5. SUGGESTIONS FOR NATIONAL INSTRUMENTS HARDWARE

Precision Suggestion: The National Instruments USB-9234:

- Plugs into the USB port of a laptop or desktop PC – and no external power is required!
- Built in IEPE power to produce the DC excitation current so that you can hook it directly up to the accelerometer
- Features BNC jacks on the front for simple connection to the sensor
- 108dB of dynamic range from 24-bit A/D converters to see background vibration levels even with large device vibration. This means you could record 50dB and 158dB, for example, on the same graph in the software.
- 6 gains built into device to zoom in on small vibration levels (preset before the "start" button is hit automatically based on the sensitivity and max. expected inputs)
- See the user's manual of this device at sine.ni.com/manuals for more information on measurement accuracy.
- (This device has AC or DC operation, but currently the software only supports DC)

Low Cost Suggestion: The National Instruments USB-6210:

- Plugs into any USB port of a laptop or desktop and does not require batteries or a separate power cord
- Features small screw terminals on the sides
- 90dB of dynamic range from a single 16-bit A/D converter.
- See the user's manual of this device at sine.ni.com/manuals for more information on measurement accuracy
- Requires an extra device to supply the excitation current to the accelerometer: suggested model 480C02 from PCB Piezotronics – http://www.pcb.com) and a few extra cables (all included in this low-cost suggestion when purchased from our website)

- See Section 7 below for the proper wiring configuration for the sensor, excitation device, and National instruments device

NOTE: If you purchase the low-cost or precision bundle from our website, all cables and the device that provides excitation current (if necessary) will be supplied to you by JustMeasure.

ALL NATIONAL INSTRUMENTS DEVICES SUPPORTED

Table 1: All National Instruments Data Acquisition Devices Supported

Device	# of Ch's	Resolution / Gains	Current Excitation?	Example NI Cable	Example NI Connector Box	Wire Connections
PCI (goes inside Desktop PC)						
PCI-4462	4	24-bit / 6	Y	N/A	Built into Device	Group D
PCI-4472	8	24-bit / 1	Y	N/A	Built into Device	Group D
PCI-4474	4	24-bit / 1	Y	N/A	Built into Device	Group D
PCI-6110	4	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6111	2	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6115	4	12-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6120	4	16-bit / 8	N	SH68-68-EP	SCB-68	Group M
PCI-6122	4	16-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6123	8	16-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6133	8	14-bit / 4	N	SH68-68-EP	SCB-68	Group M
PCI-6143	8	16-bit / 1	N	SH68-68-EP	SCB-68	Group M
PCI-6010 (37-pin)	8	16-bit / 3	N	SH37F-37M-1	CB-37F-LP	Group C
PCI-6220	8	16-bit / 4	N	RC68-68	CB-68LP	Group M
PCI-6221 (68-pin)	8	16-bit / 4	N	RC68-68	CB-68LP	Group M
PCI-6221 (37-pin)	8	16-bit / 4	N	SH37F-37M-1	CB-37F-LP	Group C
PCI-6250	8	16-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6251	8	16-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6280	8	18-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6281	8	18-bit / 7	N	SHC68-68-EPM	SCB-68	Group M
PCI-6224	16	16-bit / 4	N	RC68-68, qty 2	CB-68LPR, qty 2	Group M2
PCI-6229	16	16-bit / 4	N	RC68-68, qty 2	CB-68LPR, qty 2	Group M2
PCI-6254	16	16-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6259	16	16-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6284	16	18-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6289	16	18-bit / 7	N	SHC68-68-EPM & SHC68-68	SCB-68, qty 2	Group M2
PCI-6225	40	16-bit / 4	N	RC68-68, qty 2	CB-68LP, qty 2	Group H
PCI-6255	40	16-bit / 7	N	RC68-68, qty 2	CB-68LP, qty 2	Group H
PCI-6013	8	16-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6014	8	16-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6023E	8	12-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6024E	8	12-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6036E	8	16-bit / 4	N	R6868	CB-68LPR	Group M
PCI-6030E	8	16-bit / 14	N	SH68-68-EP	SCB-68	Group M
PCI-6032E	8	16-bit / 14	N	SH68-68-EP	SCB-68	Group M
PCI-MIO-16XE-50	8	16-bit / 8	N	SH68-68-EP	SCB-68	Group M

PCI-6040E	8	12-bit / 15	N	R6868	CB-68LP	Group M
PCI-6052E	8	16-bit / 15	N	SH68-68-EP	CB-68LPR	Group M
PCI-6070E	8	12-bit / 15	N	SH68-68-EP	SCB-68	Group M
PCI-6031E	32	16-bit / 14	N	SH1006868	SCB-68, qty 2	Group H
PCI-6033E	32	16-bit / 14	N	SH1006868	SCB-68, qty 2	Group H
PCI-6071E	32	12-bit / 15	N	SH1006868	CB-68LP	Group H
PCMCIA Devices (for Laptop PC):						
DAQCard-6024E	8	12-bit / 4	N	RC68-68	CB-68LPR	Group M
DAQCard-6036E	8	16-bit / 4	N	RC68-68	CB-68LPR	Group M
DAQCard-6062E	8	12-bit / 4	N	RC68-68	CB-68LPR	Group M
USB-Powered Devices:						
USB-6210	8	16-bit / 4	N	None Required	Built into Device	Group U
USB-6211	8	16-bit / 4	N	None Required	Built into Device	Group U
USB-6221	8	16-bit / 4	N	None Required	Built into Device	Group UM
USB-6229	16	16-bit / 4	N	None Required	Built into Device	Group UM
USB-6251	8	16-bit / 7	N	None Required	Built into Device	Group UM
USB-6259	16	16-bit / 7	N	None Required	Built into Device	Group UM
USB-9215A	4	16-bit / 1	N	None Required	Built into Device	Group UQ
USB-9215A (USB)	4	16-bit / 1	N	None Required	Built into Device	Group D
USB-9233	4	24-bit / 1	Y	None Required	Built into Device	Group D
USB-9234	4	24-bit / 1	Y	None Required	Built into Device	Group D

NOTE: **For more information on the specific devices, visit http://sine.ni.com/manuals and type in the exact model from the first column of Table 1 (above) into the search field on that website.**

6. CABLES / WIRING FOR NATIONAL INSTRUMENTS DEVICES

STEP 1: DETERMINE HOW EXCITATION IS PROVIDED

The column in Table 1 labeled "Excitation Current?" indicates whether or not the NI Device supplies the required current between 2mA and 20mA to the accelerometer automatically.

If "Y": The excitation is provided automatically and only a single cable is required (typically provided by the accelerometer manufacturer) from the sensor direct to the National instruments device. The BNC or SMB connectors on the front of the National Instruments device are clearly marked with channel numbers and correspond to the channels in your JustMeasure software application.

If "N": You have to supply a separate device that provides the excitation current. The Model 480C02 from PCB Piezotronics is the recommended device for each channel. This device is included in the low-cost bundle from the JustMeasure website. It has 2 BNC jacks: One for the sensor input and one for the output to the National Instruments device. The manufacturer of the accelerometer can provide the proper cable from the accelerometer to the "Sensor" input BNC jack. The "Output" BNC jack on this device will need a cable from the BNC jack to 2 bare wires: one for "signal", and one for "ground". The one exception is if you've purchased the USB-9215A, in which case you just need a cable with BNC plugs on both sides to connect the excitation device (model 480C02 1 ea per channel) to the National Instruments device.

NOTE: If you purchase the low-cost or precision bundle from our website, all cables and the device that provides excitation current (if necessary) will be supplied to you.

STEP 2: DETERMINE THE PROPER NI CABLE AND SCREW TERMINAL BOX

You will need a cable from National Instruments that matches that device and a screw terminal box with the screw terminals inside (see suggestions for each device in Table 1 above). The screw terminals in the connector box will be assigned numbers. These numbers DO NOT correspond to the "channel" input in the software!

STEP 3: DETERMINE WHICH SCREW TERMINALS TO USE

Use table 1 (above) to find the correct group for you your National Instruments device. Then, use Table 2 below to determine the appropriate screw terminals for the "signal" and "ground" wires coming out of the current excitation device.

NOTE: If your device is in Group D, the connections are self-explanatory and they won't be in the table below. The inputs are BNC or SMB connectors and are clearly labeled with the appropriate channel numbers. These numbers are the ones you'll use in the "1st, 2nd, 3rd, and 4th Channel" inputs in your software.

Table 2: Wire Connections for NI Devices

Group M		
Software Channel	Signal	Ground
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23

Group U		
Software Channel	Signal	Ground
0	15	16
1	17	18
2	19	20
3	21	22
4	24	25
5	26	27
6	29	30
7	31	32

Group UM		
Software Channel	Signal	Ground
0	1	2
1	4	5
2	7	8
3	10	11
4	17	18
5	20	21
6	23	24
7	26	27
8	33	34
9	36	37
10	39	40
11	42	43
12	49	50

Group C		
Software Channel	Signal	Ground
0	1	20
1	21	2
2	22	4
3	5	23
4	6	25
5	26	7
6	27	9
7	28	10

Group UQ		
Software Channel	Signal	Ground
0	0	1
1	2	3
2	4	5
3	6	7

Group M2		
Software Channel	Signal	Ground
Connector 0		
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23
Connector 1		
8	68	34
9	33	66
10	65	31
11	30	63
12	28	61
13	60	26
14	25	58

Group H		
Software Channel	Signal	Ground
Connector 0		
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23
Connector 1		
8	68	34
9	33	67
10	32	66
11	65	31
12	30	64
13	29	63
14	62	28
15	27	61
16	26	60
17	59	25
18	24	58
19	23	57
20	55	21
21	20	54
22	19	53
23	52	18
24	17	51
25	16	50
26	49	15
27	14	48
28	13	47
29	46	12
30	11	45
31	10	44
32	42	8
33	7	41
34	6	40

13	52	53
14	55	56
15	58	59

15	57	23

35	39	5
36	4	38
37	3	37
38	36	2
39	1	35

7. PC REQUIREMENTS:

Software:

- Windows 2000/XP/Vista
- Microsoft Excel 2000 or later (only if using the "export to Excel" feature)

Hardware:

- 256MB RAM
- Pentium III / Celeron 600MHz or equivalent/faster

This document serves as a repository for all the technical information we've published about this application. If we've left something out or you need more information, all e-mail is answered within 24 hours:

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